Europäisches Patentamt
European Patent Office
Office européen des brevets

(19)

(11) Publication number: **0 591 533 A1**

(12) **EUROPEAN PATENT APPLICATION published in accordance with Art. 158(3) EPC**

(21) Application number: **92909708.7**

(22) Date of filing: **11.05.92**

(86) International application number: **PCT/JP92/00598**

(87) International publication number: **WO 93/22542 (11.11.93 93/27)**

(51) Int. Cl.[5]: **F01L 1/24**

(30) Priority: **27.04.92 JP 108170/92**

(43) Date of publication of application: **13.04.94 Bulletin 94/15**

(84) Designated Contracting States: **DE FR GB**

(71) Applicant: **NITTAN VALVE CO., LTD.**
No. 7-2, Yaesu, 2-chome
Chuo-ku, Tokyo 104(JP)

(72) Inventor: **HOSAKA, Akihiko**
Nittan Valve Co. Ltd.,
7-2, Yaesu 2-chome
Chuo-ku, Tokyo 104(JP)

(74) Representative: **Klingseisen, Franz, Dipl.-Ing. et al**
Patentanwälte,
Dr. F. Zumstein,
Dipl.-Ing. F. Klingseisen,
Bräuhausstrasse 4
D-80331 München (DE)

(54) **DIRECT ACTING HYDRAULIC LASH ADJUSTER.**

(57) A direct acting hydraulic lash adjuster comprising a hydraulic unit (Y) for the lash adjuster incorporated in a bucket (X) provided with an oil supply port (2) and a sub-reservoir (4) for supplying working oil sent via the oil supply port (2) to a main reservoir (52) on the hydraulic unit (Y) side that is formed around the hydraulic unit (Y) by installing a sleeve (3) in such a manner as to extend from the inside of the bucket (X) to surround the hydraulic unit (Y), wherein an oil passage (1) is provided which communicates with the oil supply port (2) and passes circumferentially in the sub-reservoir (4) so as to be opened thereto, so that oil inside the sub-reservoir (4) is made difficult to leak to thereby prevent the entry of air into the sub-reservoir (4) and the main reservoir (52).

FIG. 1 (a)

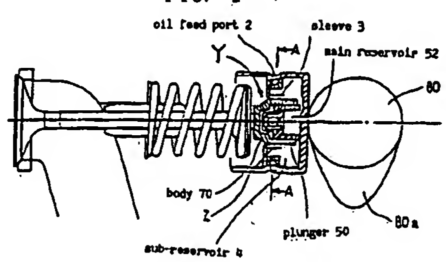
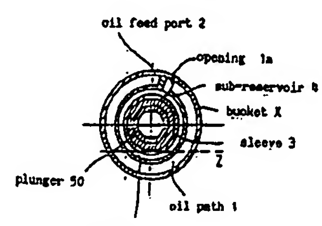


FIG. 1 (b)



EP 0 591 533 A1

Technical Field

This invention relates to an improvement of a direct acting type hydraulic lash adjuster having a hydraulic unit of the lash adjuster contained in a bucket.

Background Art

In general, a valve operating mechanism in an internal combustion engine is easily affected by abrasion and thermal expansion, and the valve clearance is changed during operation to exert bad influence on the output and noise. Thus, hydraulic lash adjusters for suitably correcting such a clearance have been used.

Among them, also in a direct acting type valve operating mechanism constituted so that a cam directly strikes the shaft end portion of a valve, for the purpose of making the equipment of the internal combustion engine light, is used a hydraulic lash adjuster as shown in Fig. 33.

Such a hydraulic lash adjuster is composed of a bucket X and a hydraulic unit Y for the hydraulic lash adjuster accommodated in the interior of the bucket X and interposed between a cam 80 and the shaft end portion of a valve 81. The above-mentioned hydraulic unit Y comprises a bottomed tubular plunger 50 with an oil hole 51 at the bottom, a similarly bottomed tubular body 70 slidably fitted on the outer peripheral surface of the plunger 50 and forming a high pressure chamber 60 between it and the bottom of the plunger, an elastic body 61 interposed within the high pressure chamber 60 and biasing the body 70 toward the closed surface thereof, a check ball 62 provided within the high pressure chamber 60 and taking charge of the operations of closing and opening the above-mentioned oil hole 51, a check ball spring 63 for holding the check ball 62 and a check ball cage 64. This hydraulic unit Y is accommodated within the bucket X, and a main reservoir 52 for holding oil is formed between the back surface of the face disk 90 of the bucket X and the hollow portion of the plunger 50, and further, a sleeve 30 is installed so as to extend from the inside surface of the bucket X and enclose the hydraulic unit Y, so that around the main reservoir 52, partitioned by the peripheral wall surface of the plunger 50, is formed a sub-reservoir 40 which communicates therewith through an overflow recess 53 and to which working oil is supplied through an oil feed path 100 of a cylinder head and an oil feed port 20 of the bucket X. On the other hand, a system is adopted in which the cam 80 and the shaft end portion of the valve 81 are brought into contact with the above-mentioned face disk 90 of the bucket X and the closed surfac of the body 70, respectively, and the cam 80 directly strikes th shaft end portion of the valve 81 through the hydraulic lash adjuster.

Such a hydraulic lash adjuster utilizes both the elastic effect due to oil leaking down to the exterior and the compression of the volume occurring in the working oil per se when pressure is applied to the working oil filled within the high pressure chamber 60, and the rigid effect of the working oil produced when pressure is further applied so that the compression of the volume does not advance any more, and further, when pressure is released, a repulsion force of the elastic body 61 provided within the high pressure chamber 60 which attempts to expand is produced, so that correcting operations are performed so as to make the clearance in the valve operating mechanism produced due to thermal expansion or the like zero.

In the case where such a conventional direct acting type hydraulic lash adjuster is mounted on a horizontal opposed type engine or an inclined engine and is not perpendicularly installed or casually used in an inclined situation, when the internal combustion engine is stopped, the working oil within both the main and sub-reservoirs 40 and 52 leaks from the clearance between the body 70 and the sleeve 30, and air enters into the place thereof.

On the other hand, when the engine is restarted, the hydraulic lash adjuster in the bottomed condition is extended to a predetermined position while performing the suction of the working oil from the reservoirs 40, 52 into the high pressure chamber 60 to make up for the lack of the working oil. Along with this, the above-mentioned entered air flows from the main reservoir 52 into the high pressure chamber 60, thereby extremely lowering the rigidity to be produced of the working oil within the high pressure chamber 60 (coming to be in a sponge-like state) when the plunger 50 is pressed, and as a result, an appropriate correction of the valve clearance can not be made and noise of the valve when seated becomes larger. Hereupon, "bottomed condition" means that in the case where the internal combustion engine is stopped with the face disk 90 of the bucket X being pushed up by the cam nose 80a, the hydraulic unit Y is compressed to the most compressed condition, as shown in Fig. 34. When the engine is restarted from such a condition, the sliding strokes of the plunger 50 and body 70 come to be at the maximum and the amount of suction of the oil into the high pressure chamber 60 comes to be at the maximum. Accordingly, at this time, the amount of suction of the above-mentioned air into the high pressur chamber 60 also comes to be at the maximum, thereby causing a remarkable reduction of the rigidity of the working oil therein.

The present invention is devised in view of the above-mentioned problems in the prior art, and a

first object of the present invention is to provide a direct acting type hydraulic lash adjuster, in which air is not absorbed into the high pressure chamber when restarting an engine by preventing air from entering into the reservoir.

A second object of the present invention is to provide a direct acting type hydraulic lash adjuster which is easy to mount therein a ring body by which an oil path is formed.

Disclosure of Invention

In order to achieve the above-mentioned objects, the direct acting type hydraulic lash adjuster according to Claim 1, wherein, as shown in Fig. 1-(a), a hydraulic unit Y of the lash adjuster is accommodated within a bucket X provided with an oil feed port 2 and a sleeve 3 is installed so as to extend from the inside of the bucket X and enclose the hydraulic unit Y, so that a sub-reservoir 4 for feeding working oil injected from said oil feed port 2 to a main reservoir 52 at the hydraulic unit Y side is formed around said hydraulic unit Y, is characterized in that, as shown in Fig.(b) taken along Line A-A of Fig. 1, an oil path 1 is provided which communicates with the oil feed port 2 and turns around in the sub-reservoir 4 until it opens into the sub-reservoir 4.

Adopting such a construction produces the operation as described below. That is, as described in the embodiment stated later, even if the working oil leaks during stoppage of the engine, leakage of the working oil is stopped when the oil level drops to the same level as the lowermost level Z of the clearance between the sleeve 3 and the body 70. Accordingly, as the construction according to the present invention is shown diagrammatically in Fig.2, if a drop in the oil level to the same level as the above-mentioned lowermost level Z occurs only within the oil path 1 provided in the sub-reservoir 4, the oil path does not drop to the position where the oil path 1 cut off, and as a result, entrance of air into the reservoirs 52, 4 is prevented.

Further, in the above-mentioned construction, in the case where the oil path 1, which turns around in the sub-reservoir 4, does not turn around more than one round, the construction of the opening 1a thereof being positioned in the vicinity of the oil feed port 2 is preferable. Moreover, the number of rounds the oil path 1 per se around the hydraulic unit Y from the oil feed port 2 may be is from one round to two rounds or more.

Further, the direct acting type hydraulic lash adjuster according to Claim 4, wherein, as shown in Fig. 13, a hydraulic unit Y of the lash adjuster is accommodated within a bucket X provided with an oil feed port 20 and a sleeve 30 is installed so as to extend from the inside of the bucket X and enclose the hydraulic unit Y, so that a sub-reservoir 40 for feeding working oil injected from said oil feed port 20 to a main reservoir 52 at the hydraulic unit Y side is formed around said hydraulic unit Y, is characterized in that, as shown in Fig. 14, taken along Line A-A of Fig. 12, a ring body 11 is accommodated within the sub-reservoir 40 and integrally provided therewith, said ring body comprising a partition wall defining a first chamber 12 which turns around like a circular ring along the formed outer wall of the reservoir in the bucket X and communicates with the oil feed port 20 and a second chamber 16 which turns around like a circular ring inside the first chamber 12 and communicates with the main reservoir 52, and a channel for forming an oil path 10, which turns around in the sub-reservoir 40 and opens into the first and second chambers 12 and 16.

With adoption of such a construction, the circular ring-like first chamber 12 in the sub-reservoir formed by the ring body 11 ensures the communicating condition between the oil feed port 20 and the first chamber 12 in the sub-reservoir, whatever position the ring body 11, which defines the first and second chambers 12, 16 within the sub-reservoir 40 and forms the oil path 10 communicating with both chambers 12 and 16, occupies in the circumference relative to the bucket.

In the above-mentioned construction, in the case where the oil path 10 which turns around in the sub-reservoir 40 does not turn more than one round, the construction of the opening 18 into the second chamber 16 in the sub-reservoir being positioned in the vicinity of the opening 14 into the first chamber 12 in the sub-reservoir is preferable. Further, the number of rounds the oil path per se around the hydraulic unit Y from the first chamber 12 in the sub-reservoir may be is one round to two rounds or more.

Brief Explanation of Drawings

Fig. 1(a) is an explanatory view showing one example of the construction according to the present invention;

Fig. 1(b) is a sectional view taken along Line A-A of Fig. 1(a);

Fig. 2 is a diagrammatic view of the construction according to the present invention;

Fig. 3 is an explanatory view showing the construction of an embodiment of the present invention provided in a valve operating mechanism of a horizontal opposed type engine;

Fig. 4 is an explanatory view showing the construction of a direct acting type hydraulic lash adjuster in th prior art provided in a valve operating mechanism of the similar construction;

Figs. 5(a), (b) and (c) ar explanatory views illustrating the leaking action of the working oil of the hydraulic lash adjuster in the prior art;
Fig. 6 is a sectional view for performing the explanatory of the length of provision of the oil path;
Figs. 7(a), (b) and (c) are sectional views for performing the explanatory of operation of the construction according to the present invention in the case where expansion and contraction of the working oil occur due to the difference in the environmental temperature in the periphery;
Figs. 8(a), (b) and (c) are explanation views showing a second embodiment of the construction according to the present invention;
Figs. 9(a) is an explanatory view showing a third embodiment of the construction according to the present invention;
Figs. 10(a) and (b) are explanatory views showing a fourth embodiment of the construction according to the invention;
Figs. 11(a) and (b) are explanatory views showing a fifth embodiment of the construction according to the present invention;
Fig. 12 is an explanatory view showing a sixth embodiment of the construction according to the present invention provided in the valve operating mechanism of a horizontal opposed type engine,
Fig. 13 is an enlarged longitudinal sectional view of the lash adjuster used in the valve operating mechanism in question;
Fig. 14 is a horizontal sectional view of a lash adjuster used in the valve operating mechanism in question (a sectional view taken along Line XIV-XIV shown in Fig. 13);
Fig. 15 is an enlarged longitudinal sectional view of a lash adjuster of a seventh embodiment with the construction according to the present invention;
Fig. 16 is an enlarged horizontal sectional view of the lash adjuster in question (a sectional view taken along Line XVI-XVI shown in Fig. 15);
Fig. 17 is an enlarged sectional view of a lash adjuster of an eighth embodiment of the construction according to the present invention;
Fig. 18 is an enlarged horizontal sectional view of a lash adjuster in question (a sectional view taken along Line XVIII-XVIII shown in Fig. 17);
Fig. 19 is an enlarged horizontal view of the lash adjuster in question (a sectional view taken along Line XIV-XIV shown in Fig. 17);
Fig. 20 is an enlarged longitudinal sectional view of a lash adjuster of a ninth embodiment according to the present invention;
Fig. 21 is an enlarged horizontal sectional view of the lash adjuster in question (a sectional view taken along Line XXI-XXI shown in Fig. 20);
Fig. 22 is an enlarged horizontal sectional view of the lash adjuster in question (a sectional view taken along Line XXII-XXII shown in Fig. 20);
Fig. 23 is an enlarged longitudinal sectional view of a lash adjuster of a tenth embodiment according to the present invention;
Fig. 24 is an enlarged horizontal sectional view of the lash adjuster in question (a sectional view taken along Line XXIV-XXIV shown in Fig. 23);
Fig. 25 is an enlarged horizontal sectional view of the lash adjuster in question (a sectional view taken along Line XXV-XXV shown in Fig. 23);
Fig. 26 is an enlarged longitudinal sectional view of a lash adjuster of an eleventh embodiment according to the present invention;
Fig. 27 is an enlarged horizontal sectional view of the lash adjuster in question (a sectional view taken along Line XXVII-XXVII shown in Fig. 26);
Fig. 28 is an enlarged horizontal sectional view of the lash adjuster in question (a sectional view taken along Line XXVIII-XXVIII shown in Fig. 26);
Fig. 29 is an enlarged longitudinal sectional view of a lash adjuster of a twelfth embodiment according to the present invention;
Fig. 30 is an enlarged horizontal sectional view of the lash adjuster in question (a sectional view taken along Line XXX-XXX shown in Fig. 29);
Fig. 31 is an enlarged horizontal sectional view of the lash adjuster in question (a sectional view taken along Line XXXI-XXXI shown in Fig. 24);
Fig. 32(a) is an explanatory view showing the construction of a direct acting type hydraulic lash adjuster relating to Claim 1 used in a valve operating mechanism in an inclined condition;
Fig. 32(b) is an explanatory view showing the construction of a direct acting type hydraulic lash adjuster relating to Claim 4 used in a similar valve operating mechanism;
Fig. 33 is a sectional view showing an example of a direct acting type hydraulic lash adjuster in the prior art; and
Fig. 34 is a view for explaining the bottomed condition of the hydraulic lash adjuster.

Best Mode for Carrying out the Invention

Now, concrete embodiments according to the present invention are explained with reference to the accompanying drawings.

Fig. 3 shows a valve operating mechanism attached to a horizontal opposed type engine. This is a direct acting type valve operating mechanism in which a hydraulic lash adjuster composed of a bucket X and a hydraulic unit Y is interposed between a cam 80 and a valve 81.

The above-mentioned hydraulic unit Y comprises a bottomed cylindrical plunger 50 having an oil hole 51 at the bottom thereof; a body 70 which

is slidably fitted on th outer peripheral surfac of the plunger 50 and which defines a high pressure chamber 60 between it and th above-mentioned bottom; and a main reservoir 52 formed within the plunger 50 and communicating with the high pressure chamber 60 through the above-mentioned oil hole 51. Besides, the hydraulic unit Y includes an elastic body placed within the high pressure chamber 60, a check ball taking charge of opening and closing the oil hole 51, a check ball spring and a check ball gauge as the components thereof.

Further, the bucket X is mounted around the hydraulic unit Y so as to cover the side of the above-mentioned main reservoir 52, and a sub-reservoir 40 communicating with the main reservoir 52 through an overflow recess 53 is formed around the hydraulic unit Y inside the main reservoir by a sleeve 30. On the peripheral wall surface of the bucket X (illustrated at the top of the peripheral wall surface of the bucket X in the same drawing) is provided an oil supply port 20 for introducing working oil, supplied from an oil feed hole (not shown) at the cylinder head side, into the sub-reservoir 40.

On the other hand, within the sub-reservoir 40 is an oil path 10 which opens in the sub-reservoir 40 after turning approximately one round therein. The oil path 10 is formed in the sub-reservoir 40 as a separate path therefrom by using a ring body of the channel-shaped cross-section and securing the edges of an opening on the outer peripheral side to the inner surface of the bucket X.

Before explaining the operation of the embodiment having the construction as shown above, the examined result of the phenomenon of leakage of the working oil in the conventional direct acting type hydraulic lash adjuster which has hitherto been used until the original idea of the present invention was provided, is mentioned.

In the case where the conventional type hydraulic lash adjuster is mounted horizontally, as shown in Fig. 4, or mounted in an inclined condition depending upon the installed mode of the valve operating mechanism, it was clear that there was a difference in the conditions of leakage of the working oil within the sub-reservoir 40, depending upon at what level the oil supply port 20 existed at the time of stoppage of an engine.

Figs. 5(a), (b) and (c) show diagrammatically a position of the oil supply port 20 in Fig. 4 and the lowermost level Z of the clearance between the sleeve 30 and the body 70. Among these drawings, in the case where the oil supply port 20 is positioned at a level higher than the above-mentioned lowermost level Z at the time of stoppage of the engine, as shown in Fig. 5, the oil supply port 20 provides an inlet for air and the clearance between the sleeve 30 and the body 70 provides an outlet for the working oil within the reservoirs 40 and 52, so that it leaks until the hatched portion (the vertical lowermost level Z of the above-mentioned clearance). Further, in the case where the oil supply port 20 and the lowermost level Z of the clearance are positioned substantially at the same level at the time of stoppage of the engine, as shown in Fig. 5(b), it is difficult for the working oil to leak since there is no relation between the above-mentioned inlet and outlet. Moreover, in the case where the oil supply port 20 is positioned at a level lower than the lowermost level Z of the clearance, as shown in Fig. 5(c), the above-mentioned clearance provides an inlet for air and the oil supply port 20 provides an outlet for the working oil within the reservoirs 40 and 52, and the action of leakage functions; however, the surface tension of the working oil in the clearance between the sleeve 30 and the body 70 prevents air from entering therein, and therefore, it is difficult for it to leak.

As apparent from the explanation as described above, in the case where the engine is stopped when the oil supply port 20 is positioned at a level higher than the lowermost level Z of the clearance between the sleeve 30 and the body 70, leakage occurs until the oil level of the working oil within the reservoirs 40 and 52 comes to the lowermost level Z. Accordingly, it is recommended to provide the construction which does not allow air to enter into the reservoirs 40 and 52 and allows the working oil to still remain therein when the oil level of the working oil drops to the same level as the lowermost level Z.

Hereupon, the inventors studied the construction which allows such a drop in the oil level, that is, causing an entrance of air, to be performed at a place independent of the interior of the reservoirs 40 and 52 but prevents air from entering into the reservoirs 40 and 52. The construction which originated as a result is the above-mentioned one of the present invention. Now, the operation of the present embodiment having the construction of the oil path 10 being further provided within the sub-reservoir 40 is explained as compared with the construction in the prior art shown in Fig. 4.

With the construction of the present embodiment as described above, in the case where the oil supply port 20 is positioned at a level higher than the lowermost level Z of the clearance between the sleeve 30 and the body 70 at the time of stoppage of the engine, a drop in the oil level occurs within the above-mentioned oil path 10 until the same level as the lowermost level Z in question, as shown in Fig. 2 diagrammatically, and ther is no more drop in oil level, that is, more than until the place where the oil path 10 is cut off, so that the oil path 10 in front therefrom and the interior of the reservoirs 40 and 52 are filled with the working oil,

thereby precluding the possibility of drawing air into the high pressure chamber 60.

Conversely from the above, considering the required length of the oil path 10 in the construction of the present invention, when the oil supply port 20 is positioned at a level a little higher than the lowermost level Z of the clearance between the sleeve 30 and the body 70, as shown in Fig. 6, the oil level of the working oil within the oil path 10 comes to be above the extended line of the lowermost level Z at the left side of the drawing. Accordingly, the oil path 10 must extended to a level a little lower than the extended line of the lowermost level Z.

On the other hand, in the explanation made heretofore, the action of leakage of oil has been considered under a situation where there is no expansion and contraction of the working oil due to a difference in the daytime and nighttime environmental temperatures; however, there occurs an action of leakage of the working oil due to such a difference in environmental temperatures depending upon the situation, thereby sometimes causing a leakage of the working oil.

Namely, even in the case where the oil supply port 20 is positioned lower than the lowermost level Z of the clearance between the sleeve 30 and the body 70, the working oil leaks from the oil supply port 20 when the environmental temperature is high in the daytime and the working oil expands, and air is drawn from the oil supply port 20 when the environmental temperature drops in night and the working oil contracts.

Such air gathers gradually upwardly of the oil path 10, as shown in Fig. 7(a). Once air is drawn therein, leakage of the working oil and entrance of air increases like a curve of the second degree depending on a difference in environmental temperature since the rates of expansion and contraction of air are larger than those of the working oil, and air within the oil path 10 communicates with the oil supply port 20 at the place where air expands, as shown with the broken line in Fig. 7(b), finally resulting in the same situation as in the case where the oil supply port 20 is higher than the lowermost level Z of the above-mentioned clearance, so that the oil level in the oil path 10 drops and oil leaks until the position of the broken line of the lowermost level Z is reached, as shown in Fig. 7(c).

When the working oil contracts in such a situation, the oil level in the oil path 10 comes to the position of the full line shown in Fig. 7(c).

Accordingly, also in the case where the oil path 10 is provided without turning more than one round within the sub-reservoir 40, the oil path 10 is preferably designed so that the opening 18 thereof comes near the oil supply port 20, as shown in Fig. 7.

Figs. 8(a) and (b), Figs. 9(a) and (b) and Figs. 10(a) and (b) are horizontal sectional views and longitudinal sectional views of hydraulic lash adjusters showing other embodiments (second to fourth embodiments) according to the present invention, respectively. These oil paths 10 are provided turning substantially one round within the sub-reservoir 40. On the other hand, Figs. 11(a) and (b) also show the construction of a further embodiment according to the present invention, and the oil path 10 is provided turning more than one round within the sub-reservoir 40.

Figs. 12 to 14 show a sixth embodiment according to the present invention, Fig. 12 showing a valve operating mechanism, Fig. 13 a longitudinal sectional view of a hydraulic lash adjuster and Fig. 14 a horizontal sectional view of the same lash adjuster.

In this embodiment, a ring body 11A is integrally accommodated within a sub-reservoir 40 so that there are formed therein an annular sub-reservoir first chamber 12 along the inner periphery of a bucket X; a sub-reservoir second chamber 16 positioned inside the first chamber 12 and turning around a main reservoir 52; and an oil path 10 turning around along the border of the first and second chambers 12, 16 and communicating with the first and second chambers 12, 16, respectively. That is, the ring body 11A is so constructed that an oil path-defining wall 17 having an L-shaped cross section is integrally connected to the inside of the cylindrical longitudinal wall 13, which divides the sub-reservoir 40 into the first chamber 12 and the second chamber 16, and the oil path-defining wall 17 cooperates with the sleeve 30 to form the oil path 10. The ring body 11A is integrally joined to, for example, the sleeve 30.

Downwardly of the longitudinal wall 13 is provided an opening 14 through which the first chamber 12 communicates with the oil path 10. In the vicinity of the opening 14 of the oil path-defining wall 17 having an L-shaped cross

Figs. 12 to 14 show a sixth embodiment according to the present invention, Fig. 12 showing a valve operating mechanism, Fig. 13 a longitudinal sectional view of a hydraulic lash adjuster and Fig. 14 a horizontal sectional view of the same lash adjuster.

In this embodiment, a ring body 11A is integrally accommodated within a sub-reservoir 40 so that there are formed therein an annular sub-reservoir first chamber 12 along the inner periphery of a bucket X; a sub-reservoir second chamber 16 positioned inside the first chamber 12 and turning around a main reservoir 52; and an oil path 10 turning around along the border of the first and second chambers 12, 16 and communicating with

the first and second chambers 12, 16, respectively. That is, the ring body 11A is so constructed that an oil path-defining wall 17 having an L-shaped cross section is integrally connected to the inside of the cylindrical longitudinal wall 13, which divides the sub-reservoir 40 into the first chamber 12 and the second chamber 16, and the oil path-defining wall 17 cooperates with the sleeve 30 to form the oil path 10. The ring body 11A is integrally joined to, for example, the sleeve 30.

Downwardly of the longitudinal wall 13 is provided an opening 14 through which the first chamber 12 communicates with the oil path 10. In the vicinity of the opening 14 of the oil path-defining wall 17 having an L-shaped cross section is provided an opening 18 through which the oil path 10 communicates with the sub-reservoir second chamber 16. That is, the oil supply port 20 communicates, through both the sub-reservoir first chamber 12 which turns around and the oil path 10 which turns around, with the sub-reservoir second chamber 16 communicating with the main reservoir 52, thereby providing a construction where it is more difficult for air to enter into the main reservoir 52 as compared with those of the above-mentioned first to fifth embodiments.

To assemble the lash adjuster, the ring body 11 is first accommodated within the bucket X, the sleeve 30 is thereafter accommodated in and further caulked and secured to the bucket X, so that the ring body 11 is integrally held between the sleeve 30 and the bucket face part. Alternatively, the ring body 11, which is previously integrally joined to the sleeve 30, may be incorporated into the bucket, and then caulked and secured thereto. In this connection, Reference character 31 designates the caulked portion. In this embodiment, whatever position the ring body 11A takes in the peripheral direction with respect to the bucket X, the oil supply port 20 will open into the sub-reservoir first chamber 12, and therefore, incorporating the ring body 11 at the time it is aligned with the oil supply port 20 of the bucket X is not necessary.

Figs. 15 and 16 show a seventh embodiment according to the present invention, Fig. 15 being an enlarged longitudinal sectional view of a lash adjuster and Fig. 16 being an enlarged horizontal sectional view of the lash adjuster (sectional view taken along Line XIV-XIV in Fig. 15).

In this seventh embodiment, a ring body 11B defines a sub-reservoir first chamber 12 at the face side of a bucket X, and an oil supply port 20 provided in th bucket X extends obliquely to communicate with the sub-reservoir first chamber 12. The ring body 11B is so constructed that an oil path-defining wall 17 having a channel-shaped cross section is integrally connected to the lower edge of a cylindrical longitudinal wall 13, and the longitudinal wall 13 is curved outwardly at the upper end portion thereof so that its contact area with the bucket face portion is made larger to enhance a sealing property. Further, the outer surface of the oil path-defining wall 17 of the ring body 11B engages the inner peripheral surface of the bucket X to thereby position the ring body 11B in the bucket X. Many other parts are the same in construction as those in the lash adjuster according to the above-mentioned sixth embodiment, and so, they are affixed with the same reference characters to omit the explanation thereof.

Figs. 17 to 19 show an eighth embodiment according to the present invention, Fig. 17 being an enlarged longitudinal sectional view of a lash adjuster and Figs. 18 and 19 being enlarged horizontal sectional views of the lash adjuster.

In the eighth embodiment, a ring body 11C is so constructed that an oil path 10 is formed spirally inside an oil path-defining wall 17 which is made to come into contact with the longitudinal wall of a sleeve 30 and the inner peripheral wall of the bucket X, and a vertical through-hole provided on the oil path-defining wall 17 forms an opening 18 which opens in a sub-reservoir second chamber 16.

Similarly to the ring body 11B in the above-mentioned seventh embodiment, the ring body 11C is so constructed that an oil path-defining wall 17 having a channel-shaped cross section is integrally connected to the lower edge of a cylindrical longitudinal wall 13 which divides a sub-reservoir 40 into a first chamber 12 and a second chamber 16; however, the oil path-defining wall 17 is formed with a groove extending spirally, which forms the oil path 10 turning one and a half rounds. Further, the oil path-defining wall 17 engages the inner peripheral surface of a bucket and the longitudinal wall of a sleeve to position the ring body 11c.

Figs. 20 to 22 show a ninth embodiment according to the present invention, Fig. 20 being an enlarged longitudinal sectional view of a lash adjuster and Figs. 21 and 22 being enlarged horizontal sectional views of the lash adjuster.

The ring body 11D in the ninth embodiment is composed of longitudinal walls 13 having an H-shaped cross section, a sub-reservoir fist chamber 12 being formed outside the outer longitudinal wall 13a and a sub-reservoir second chamber 16 being formed inside the inner longitudinal wall 13b. In the region interposed between the inner and outer longitudinal walls 13a and 13b are formed two vertical oil paths 10a and 10b, and the two oil paths 10a and 10b communicate with each other through a hole 10c provided on the horizontal partition wall. Moreover, on the longitudinal wall 13b is provided an opening 18 through which an oil path 10a com-

municates with the second chamber.

Figs. 23 to 25 show a tenth embodiment according to the present invention, Fig. 23 being an enlarged longitudinal sectional view of a lash adjuster and Figs. 24 and 25 being enlarged horizontal sectional views of the lash adjuster.

A ring body 11E in the tenth embodiment comprises an extended portion with a modified T-shaped cross section which defines an oil path 10 and which is integrally connected inside a cylindrical longitudinal wall 13. On the extended portion with a modified T-shaped cross section is provided a vertical through-hole 18e through which the oil path 10 and a sub-reservoir second chamber communicate with each other. Further, inside the oil path 10 is formed an oil path 10e turning around the longitudinal wall of a sleeve, by the extended portion 17 with a modified T-shaped cross section. The oil path 10e and the oil path 10 communicate with each other through a cut-out portion 17e provided on the T-shaped extended portion 17. In addition, on the longitudinal wall of the sleeve 30 facing the oil path 10e is provided a small air vent hole 30a, so that air within the sub-reservoir 40 is positively led out of both the small air vent hole 30a and the clearance between the sleeve and the body, thereby preventing air from entering into the main reservoir 52.

Figs. 26 to 28 show an eleventh embodiment according to the present invention, Fig. 26 being an enlarged longitudinal sectional view of a lash adjuster and Figs. 27 and 28 being enlarged horizontal sectional views of the lash adjuster.

In the ring body 11E in the above-mentioned tenth embodiment, the oil path 10 and the oil path 10e communicate with each other through one cut-out portion formed on the T-shaped extended portion 17; however, a ring body 11F is so constructed that 8 cut-out portions 17f equally arranged in the peripheral direction are provided at the lower edge of the longitudinal wall of the T-shaped extended portion, and the oil path 10 and the oil path 10e communicate with each other through the cut-out portions 17f. Other parts are the same in construction as those of the ring body shown in the above-mentioned tenth embodiment, and so, the explanation thereof is omitted.

Figs. 29 to 31 show a twelfth embodiment according to the present invention, Fig. 29 being an enlarged longitudinal sectional view of a lash adjuster and Fig. 30 being an enlarged horizontal sectional view of the lash adjuster.

In this twelfth embodiment, a ring body 11G is so constructed that a flange-like horizontal extended portion, which cooperates with a sleeve 30 to form an oil path 10, is integrally connected inside a cylindrical longitudinal wall 13 which separates and defines a sub-reservoir first chamber 12 and a sub-reservoir second chamber 16. Other parts are the same in construction as those of the ring body 11F shown in the above-mentioned eleventh embodiment, and are affixed with the same reference characters to omit the explanation thereof.

As described above, the present embodiment shows the construction of a direct acting type hydraulic lash adjuster in a horizontal opposed type engine in which a valve operating mechanism is horizontally provided; however, of course, the construction of the present invention may be applied also to a direct acting type hydraulic lash adjuster in which a valve operating mechanism is obliquely provided, as shown in Figs. 32 (a) and (b), and provides similar advantageous effects.

Industrial Applicability (Effects of the Invention)

As described in detail, the direct acting type hydraulic lash adjuster as set forth in Claim 1 prevents an entrance of air into both the main and sub-reservoirs, because in the case where leakage of the working oil from the above-mentioned clearance occurs at the time of stoppage of an engine, a drop in the level of the working oil (an entrance of air) due to such a leakage only occurs in the oil path. Accordingly, also when an internal combustion engine is restarted from the bottomed condition, suction of air into the high pressure chamber is suppressed, and therefore, the primary function to be fulfilled by the hydraulic lash adjuster is most effective.

The direct acting type hydraulic lash adjuster as set forth in Claim 4 comprises a sub-reservoir first chamber in the form of a circular ring, and therefore, whatever position the ring body, which divides the sub-reservoir into a first chamber and a second chamber and forms an oil path communicating with both chambers, occupies in the peripheral direction with respect to the bucket, communication of the oil supply port with the sub-reservoir first chamber is ensured, so that when the oil lash adjuster is incorporated, that is, when the ring body is incorporated into the bucket, there is no need of the ring body being positioned in the peripheral direction, and accordingly, assembly of the lash adjuster is simplified.

Claims

1. A direct acting type hydraulic lash adjuster, wherein a hydraulic unit of the lash adjuster is accommodated within a bucket provided with an oil feed port and a sleeve is installed so as to extend from the inside of the bucket and enclose the hydraulic unit, so that a sub-reservoir for feeding working oil injected from said

oil feed port to a main reservoir at th hydraulic unit side is formed around said hydraulic unit, characterized in that, an oil path is provided which communicates with the oil feed port and turns around in the sub-reservoir until it opens into the sub-reservoir.

2. A direct acting type hydraulic lash adjuster as claimed in Claim 1, characterized in that said opening of the oil path turning around in the sub-reservoir is positioned near the oil supply port.

3. A direct acting type hydraulic lash adjuster as claimed in Claim 1, characterized in that said oil path is provided turning one round to two rounds or more from the oil supply port.

4. A direct acting type hydraulic lash adjuster, wherein, a hydraulic unit of the lash adjuster is accommodated within a bucket provided with an oil feed port and a sleeve is installed so as to extend from the inside of the bucket and enclose the hydraulic unit, so that a sub-reservoir for feeding working oil injected from said oil feed port to a main reservoir at the hydraulic unit side is formed around said hydraulic unit, characterized in that, a ring body is accommodated within the sub-reservoir and integrally provided therewith, said ring body comprising a partition wall defining a first chamber which turns around like a circular ring along the formed outer wall of the reservoir of the bucket and communicates with the oil feed port and a second chamber which turns around like a circular ring inside the first chamber and communicates with the main reservoir, and a channel for forming an oil path, which turns around in the sub-reservoir and opens into the first and second chambers.

5. A direct acting type hydraulic lash adjuster as claimed in Claim 4, characterized in that said opening of said oil path into the sub-reservoir second chamber is provided near the opening of said oil path into the sub-reservoir first chamber.

6. A direct acting type hydraulic lash adjuster as claimed in Claim 4, characterized in that said opening of said oil path into the sub-reservoir second chamber is provided turning one round to two rounds or more from the opening into the sub-reservoir first chamber.

FIG. 1 (a)

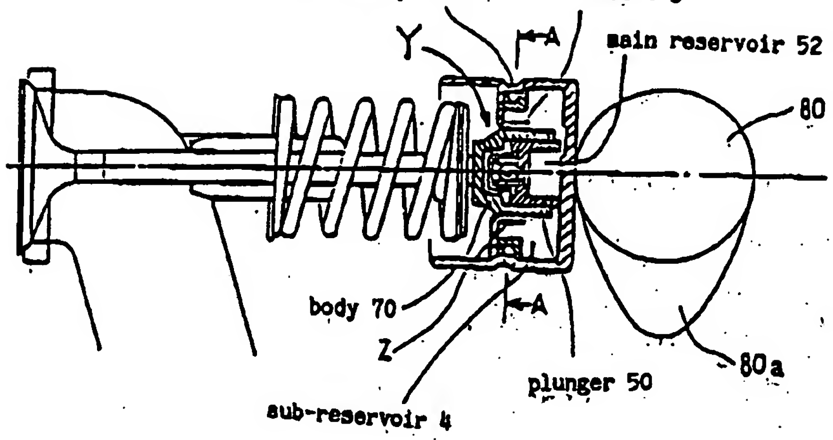


FIG. 1 (b)

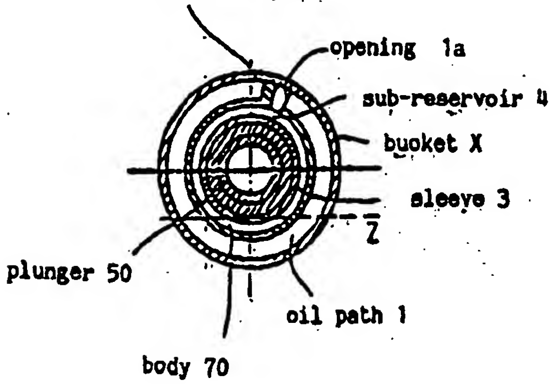


FIG. 2

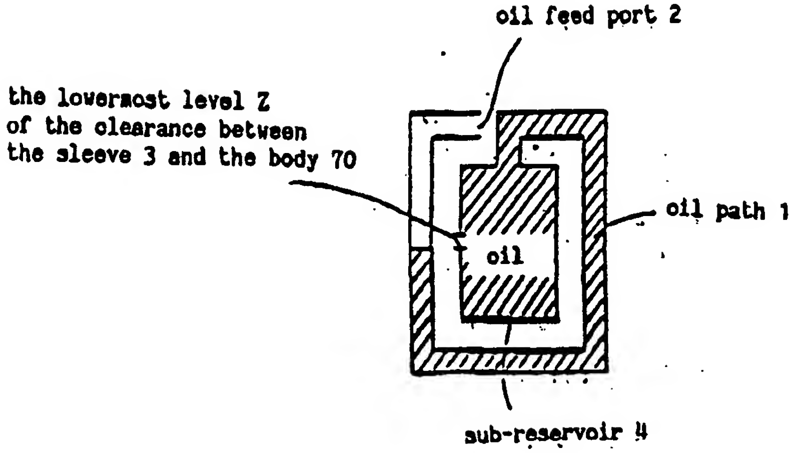


FIG. 3

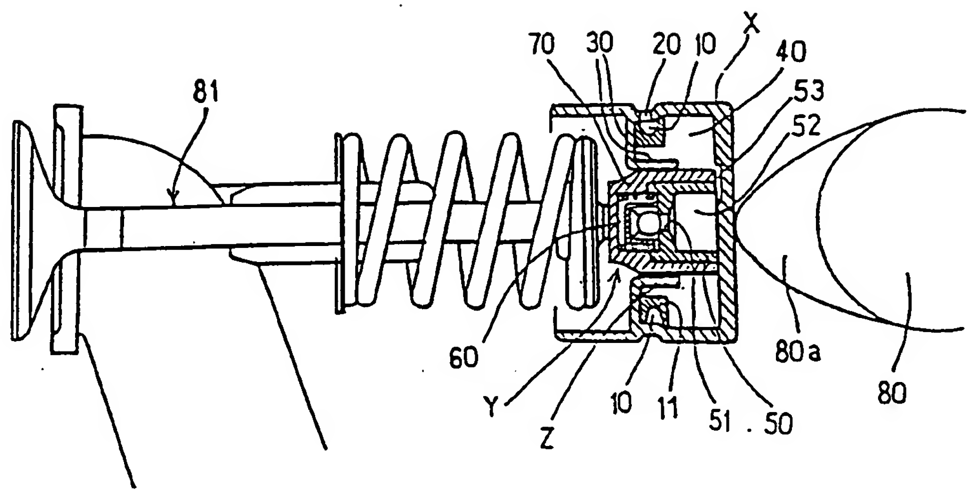

70
30
20
10
X
40
53
52
81
60
Y
Z
10
11
51
50
80a
80

FIG. 4

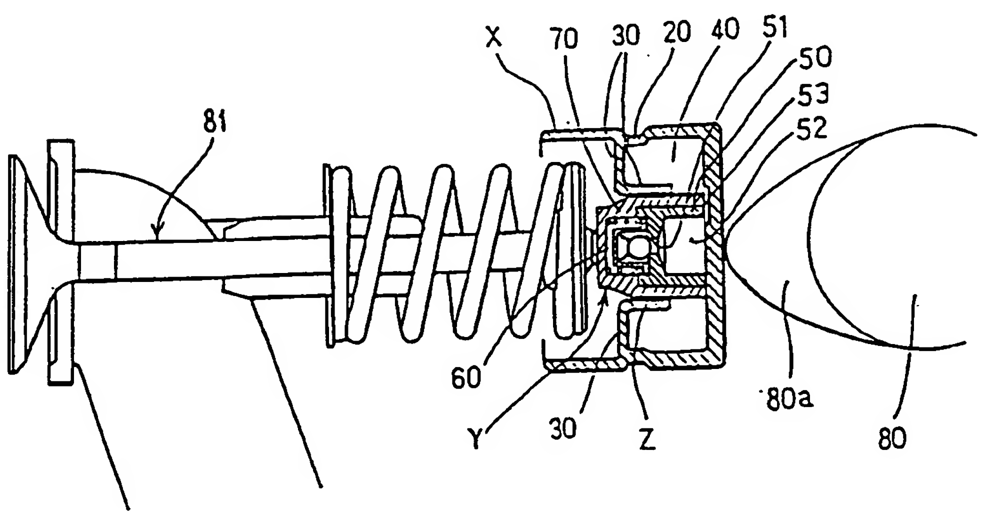

X
70
30
20
40
51
50
53
52
81
60
Y
30
Z
80a
80

FIG. 5

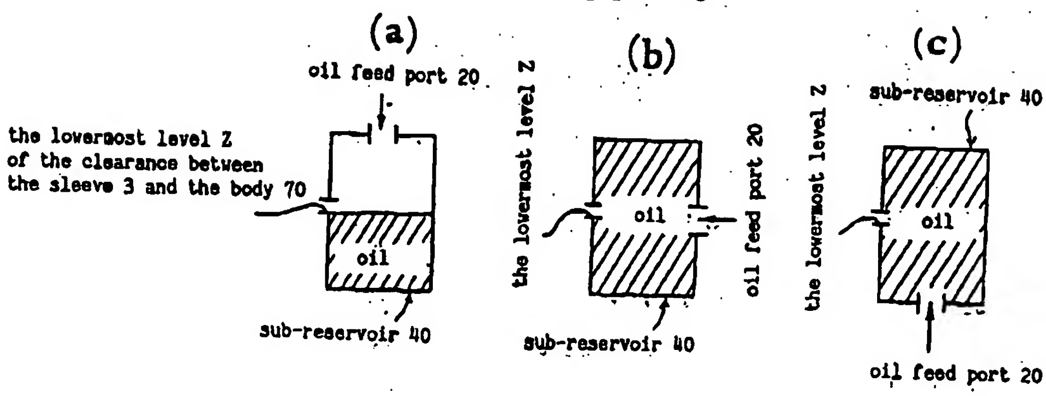

(a)
oil feed port 20
the lowermost level Z
of the clearance between
the sleeve 3 and the body 70
oil
sub-reservoir 40
(b)
the lowermost level Z
oil
oil feed port 20
sub-reservoir 40
(c)
sub-reservoir 40
the lowermost level Z
oil
oil feed port 20

FIG. 6

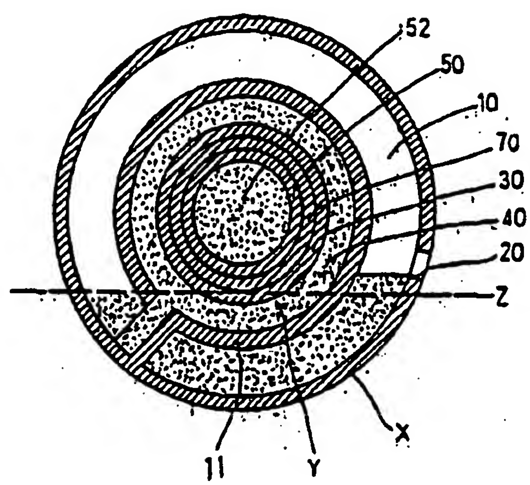
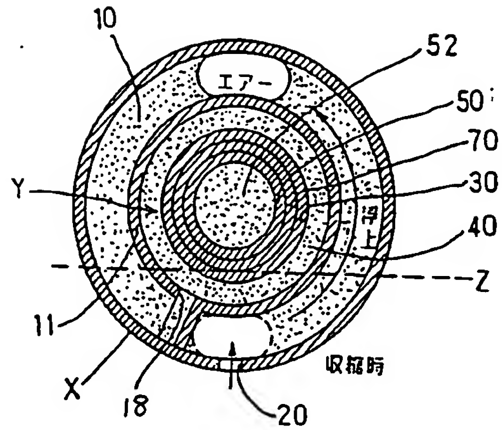
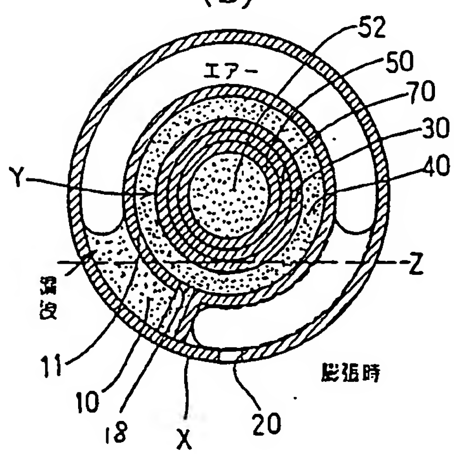

52
50
10
70
30
40
20
Z
X
11
Y

FIG. 7 (a)


10
52
エアー
50
70
30
Y
浮上
40
Z
11
X
18
収縮時
20

(b)


52
50
エアー
70
30
Y
40
Z
11
10
18
X
膨張時
20

(c)

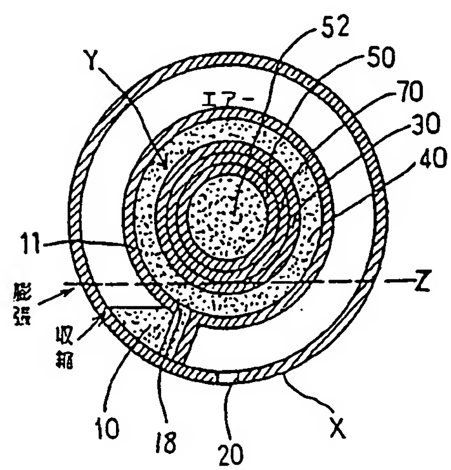

52
50
Y
エアー
70
30
40
11
Z
膨張
収縮
10
18
20
X

FIG. 8

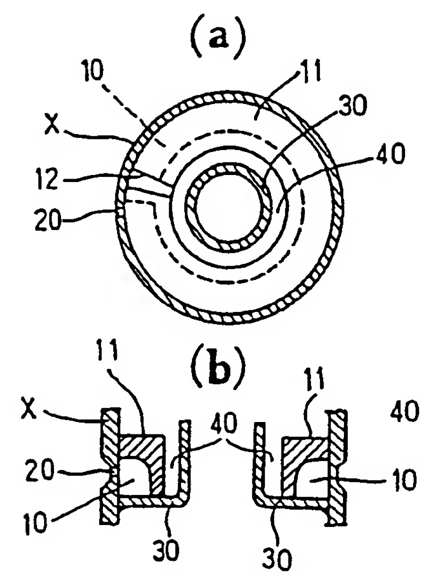

(a)
10
11
30
X
40
12
20
(b)
11
11
X
40
40
20
10
10
30
30

FIG. 9

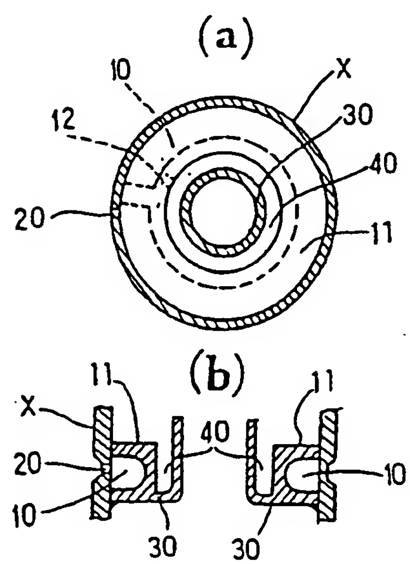

(a)
10
X
12
30
40
20
11
(b)
11
11
X
40
20
10
10
30
30

FIG. 10

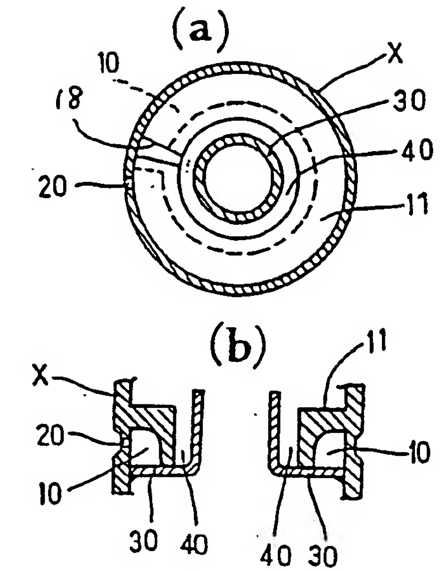

(a)
10
18
20
X
30
40
11
(b)
X
20
10
30
40
11
10
40
30

FIG. 11

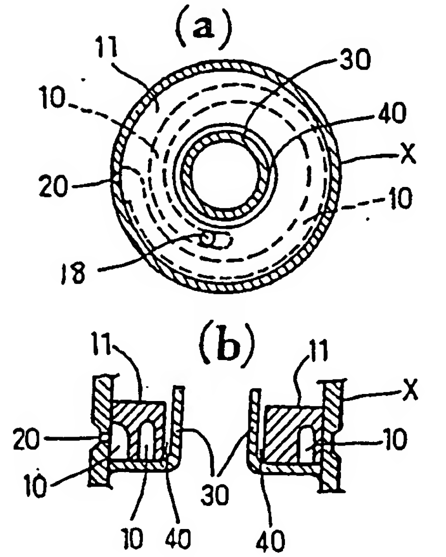

(a)
11
10
20
18
30
40
X
10
(b)
11
20
10
10
40
30
11
X
10
40

FIG. 12

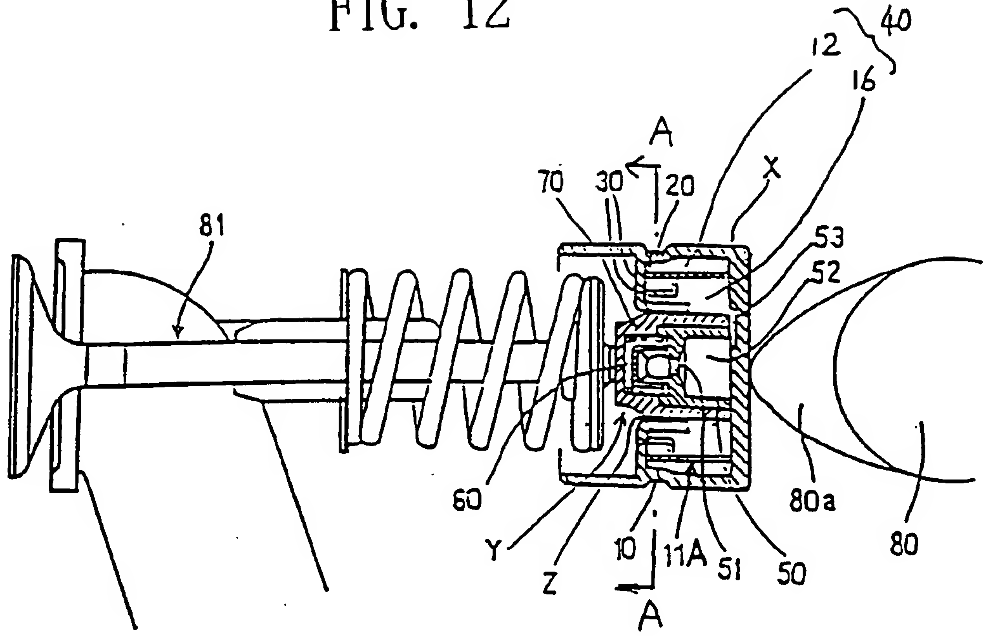

40
12
16
A
70
30
20
X
53
52
81
60
Y
Z
10
11A
51
50
80a
80
A

FIG. 13

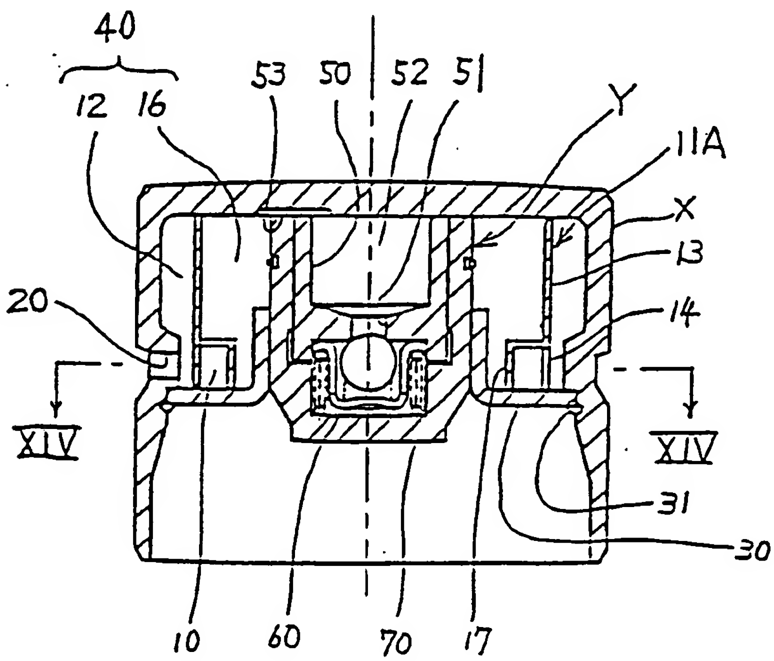

40
12
16
53
50
52
51
Y
11A
X
13
14
20
XIV
XIV
31
30
10
60
70
17

FIG. 14

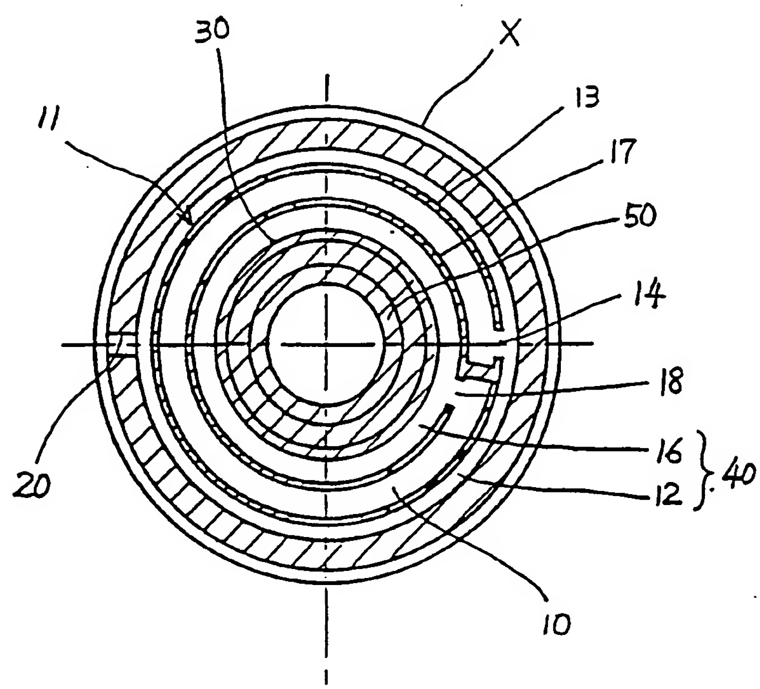

30
X
11
13
17
50
14
18
20
16
12
40
10

FIG. 15

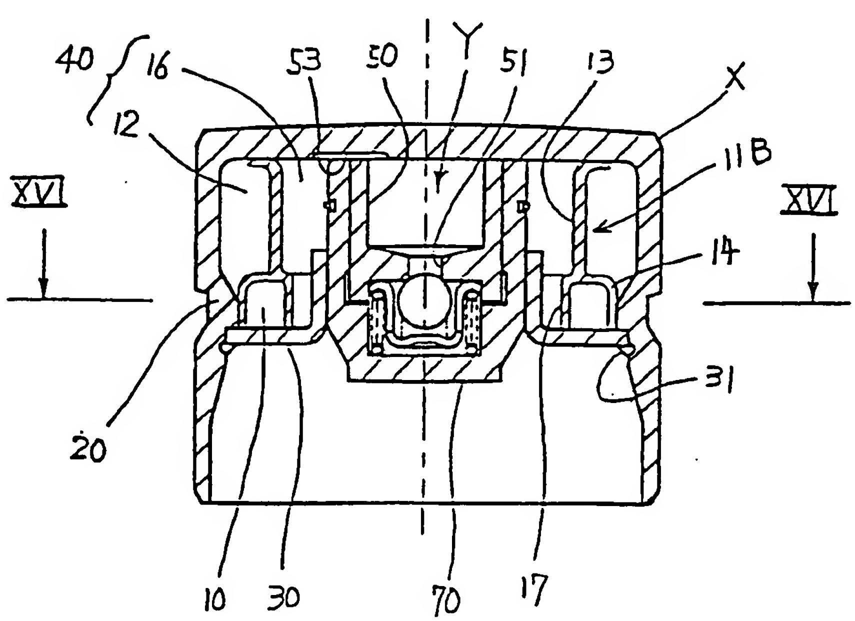

40
16
12
53
50
Y
51
13
X
11B
XVI
XVI
14
31
20
10
30
70
17

FIG. 16

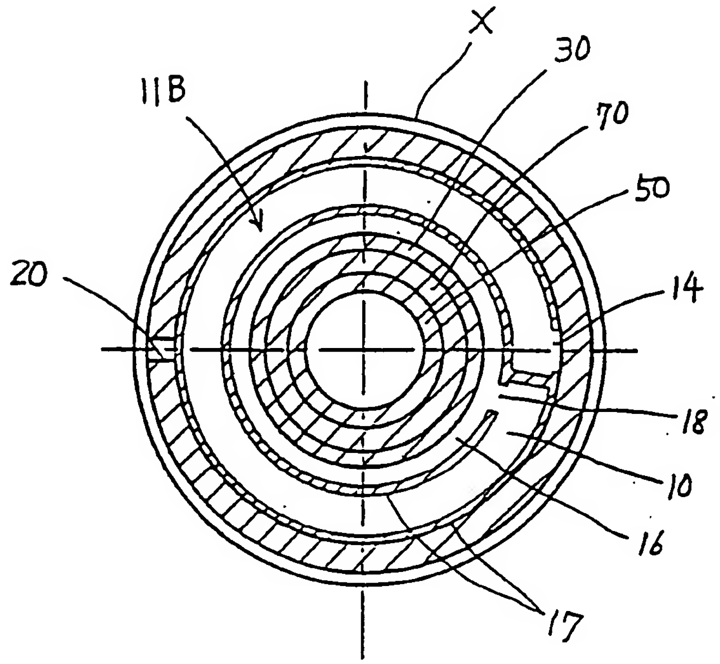

X
30
11B
70
50
20
14
18
10
16
17

FIG. 17

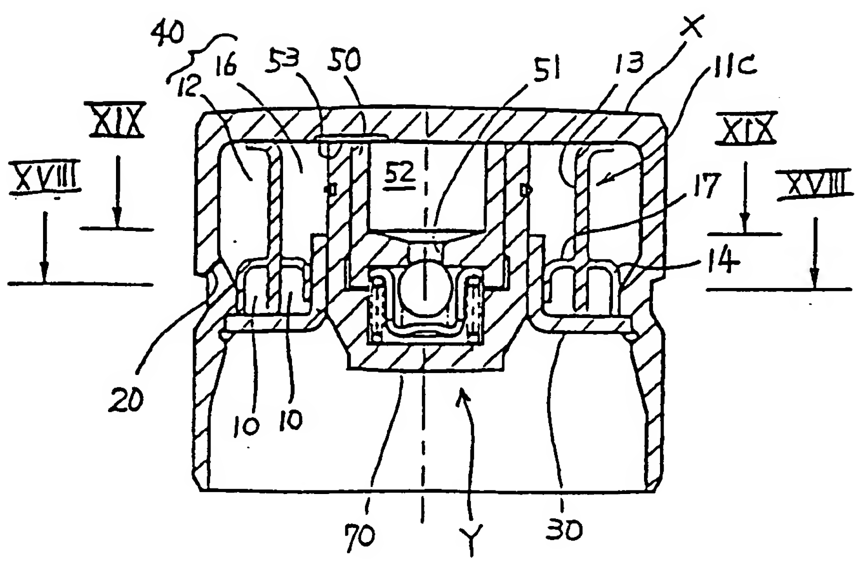

40
12
16
53
50
51
13
X
11C
XIX
XVIII
52
17
14
20
10
10
70
Y
30

FIG. 18

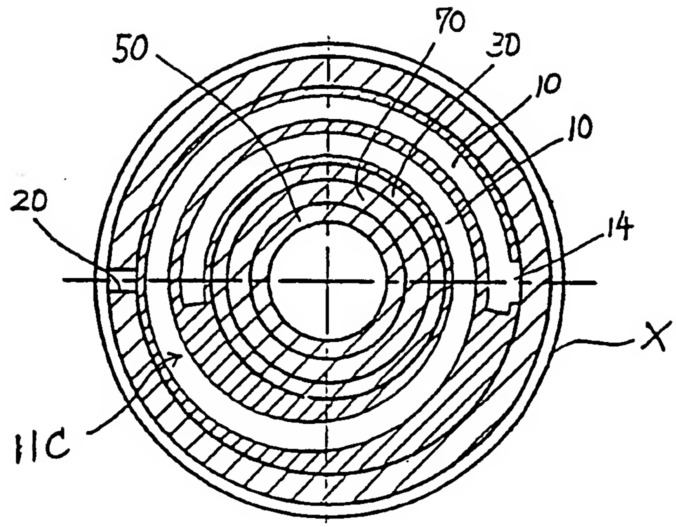


FIG. 19

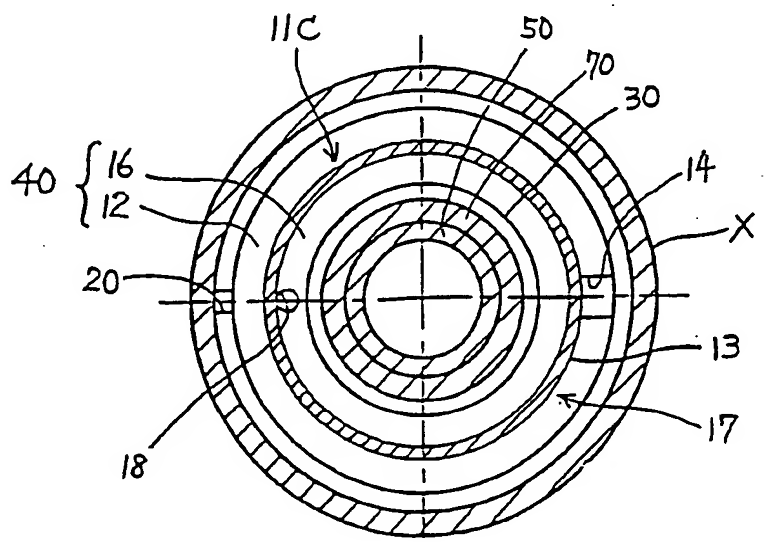


FIG. 20

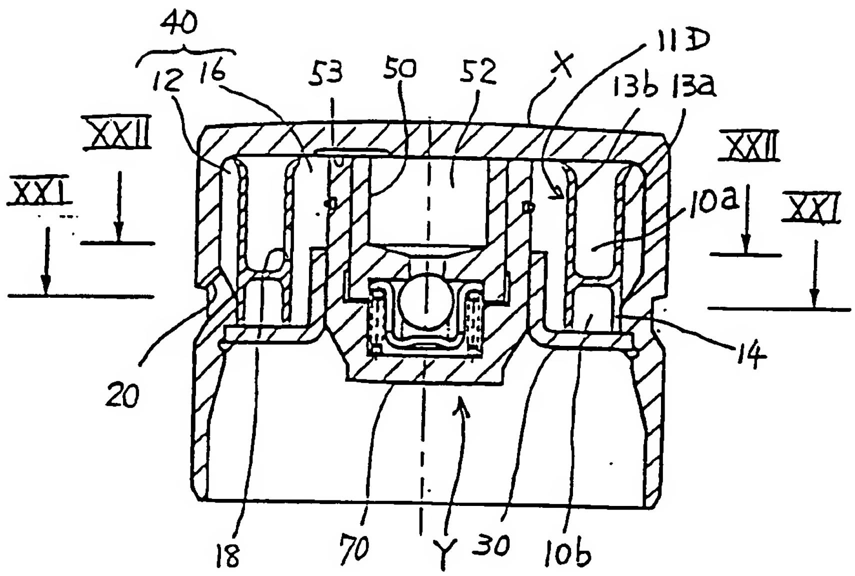

40
12
16
53
50
52
X
11D
13b
13a
XXII
XXI
10a
14
20
18
70
Y
30
10b

FIG. 21

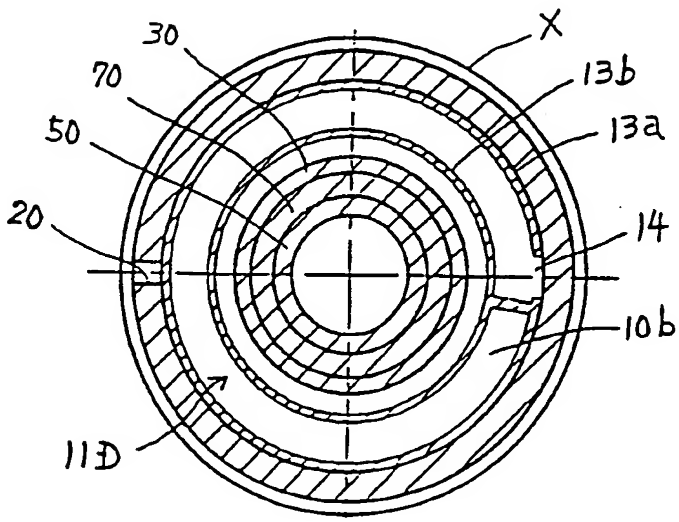

30
X
13b
70
13a
50
20
14
10b
11D

FIG. 22

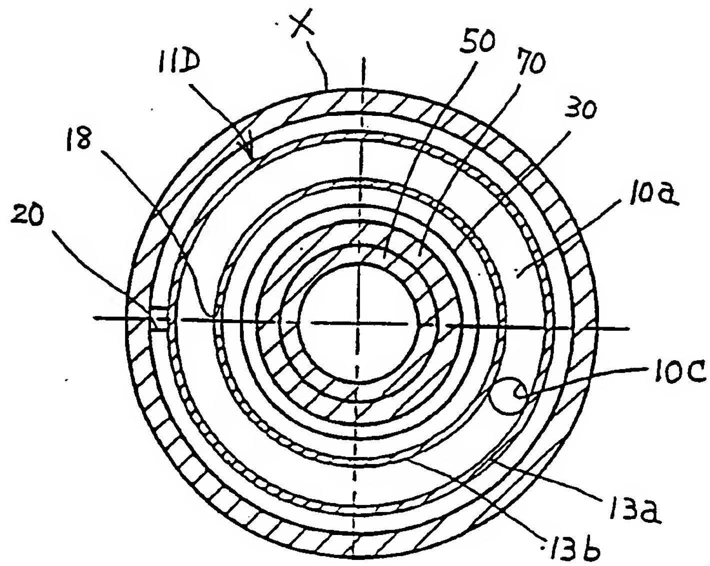

X
11D
50
70
30
18
10a
20
10c
13a
13b

FIG. 23

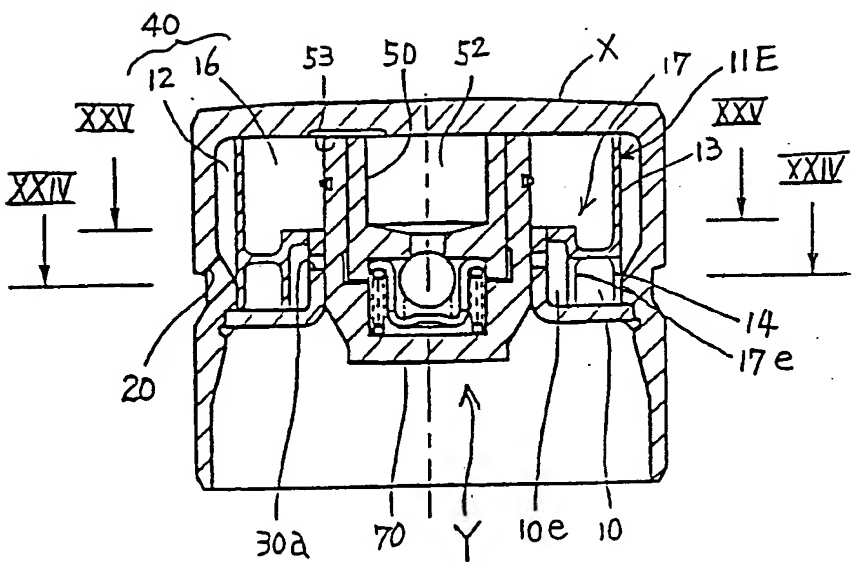

40
12
16
53
50
52
X
17
11E
XXV
XXV
13
XXIV
XXIV
14
17e
20
30a
70
Y
10e
10

FIG. 24

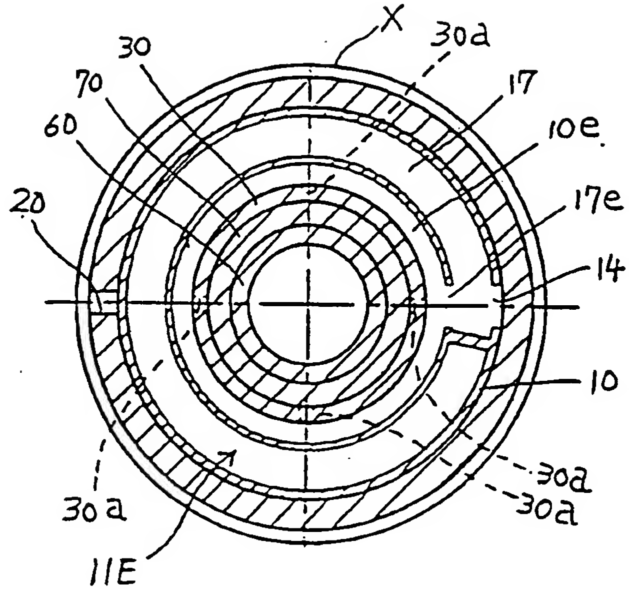

X
30a
30
70
17
60
10e
20
17e
14
10
30a
30a
30a
11E

FIG. 25

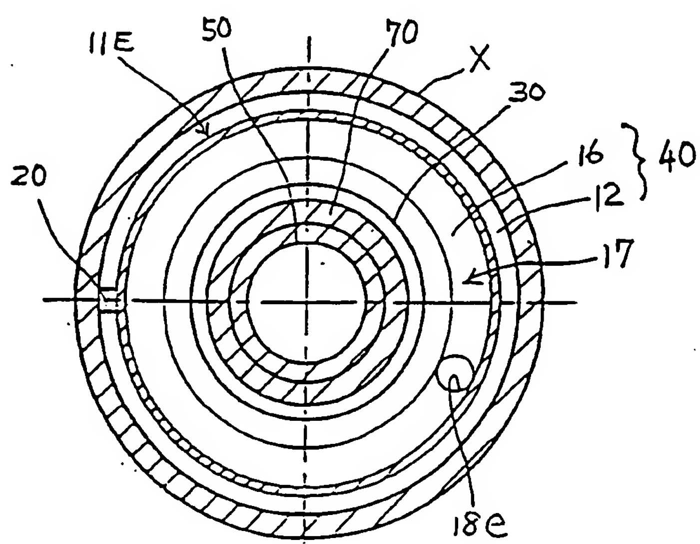

11E
50
70
X
30
20
16
40
12
17
18e

FIG. 26

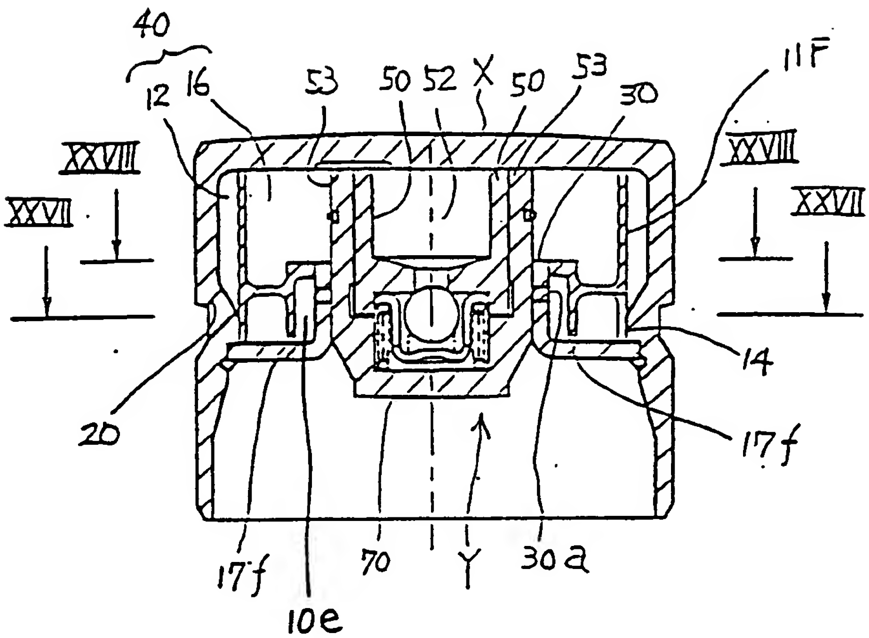

40
12
16
53
50
52
X
50
53
30
11F
XXVIII
XXVII
XXVIII
XXVII
14
20
17f
17f
70
Y
30a
10e

FIG. 27

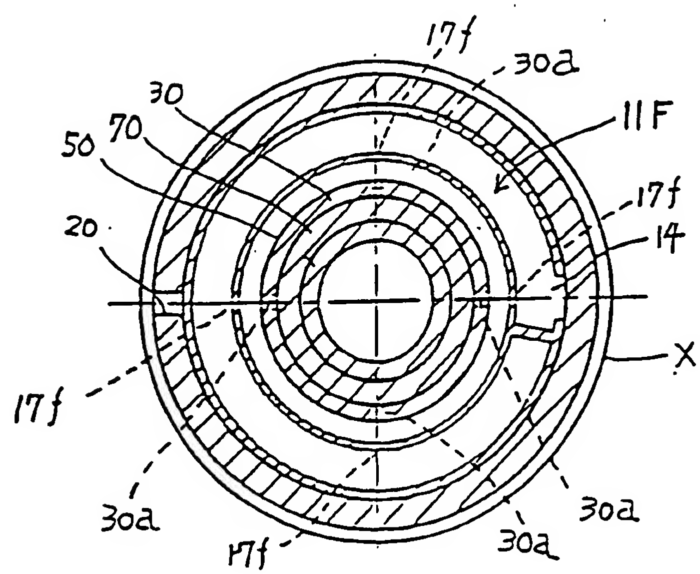

17f
30a
30
70
50
11F
17f
20
14
X
17f
30a
30a
30a
17f

FIG. 28

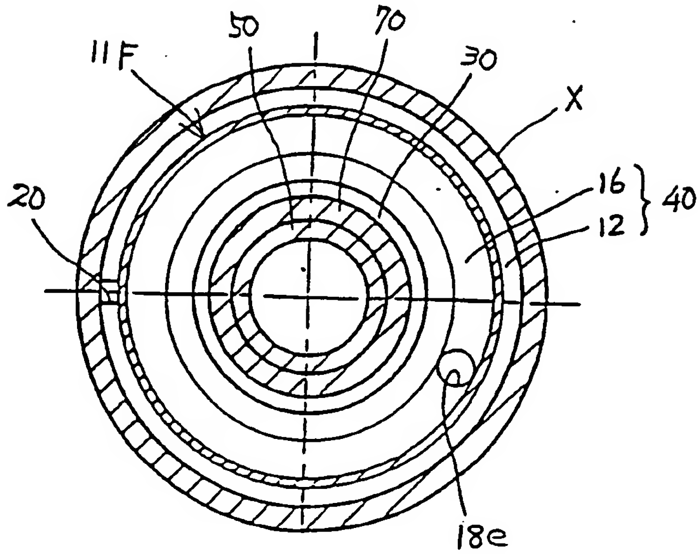

50
70
30
11F
X
20
16
40
12
18e

FIG. 29

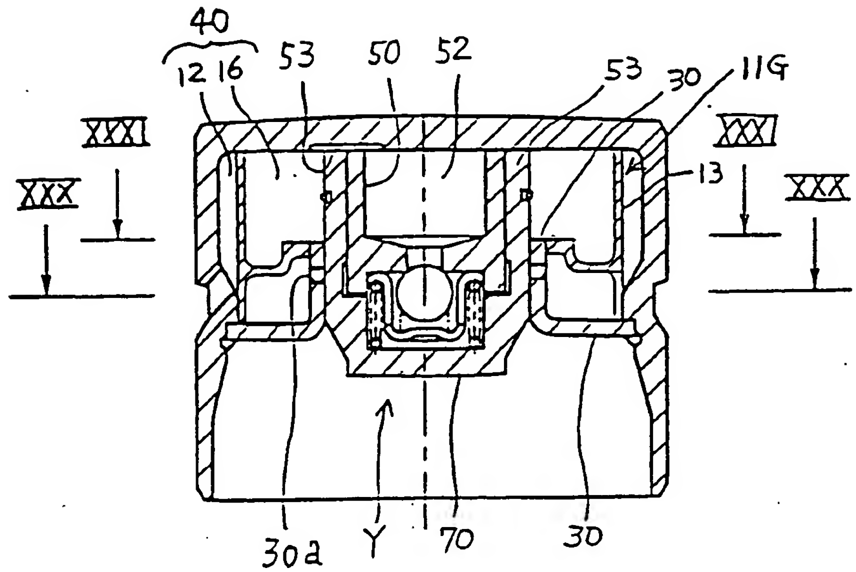

40
12
16
53
50
52
53
30
11G
XXXI
XXXI
XXX
XXX
13
30a
Y
70
30

FIG. 30

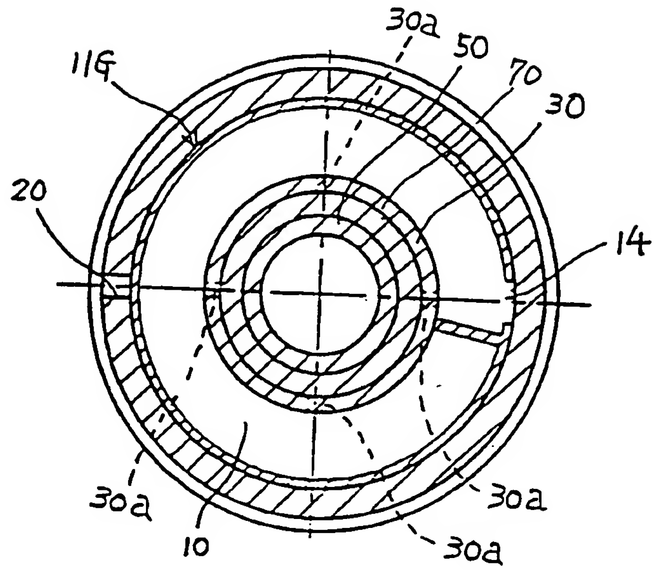


FIG. 31

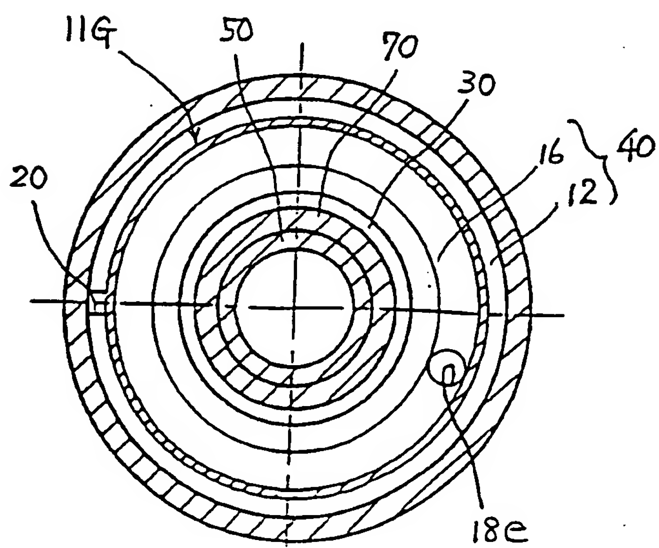


FIG. 32 (a)

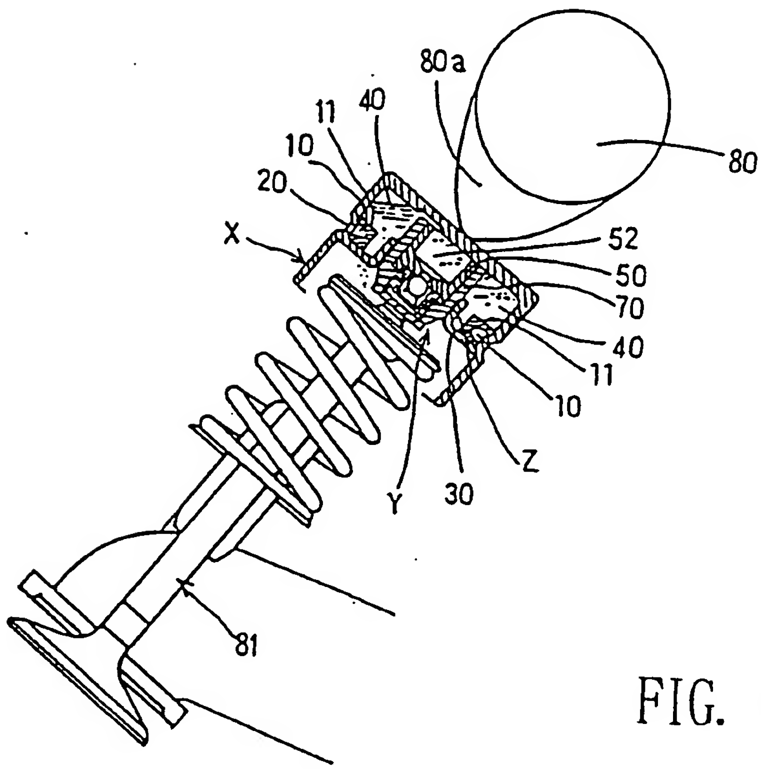


FIG. 32 (b)

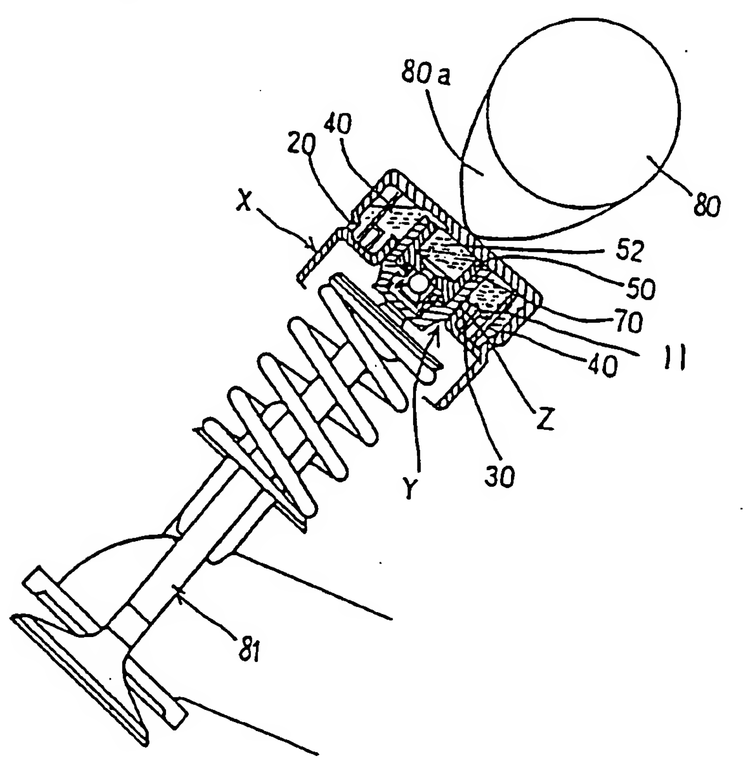


FIG. 33

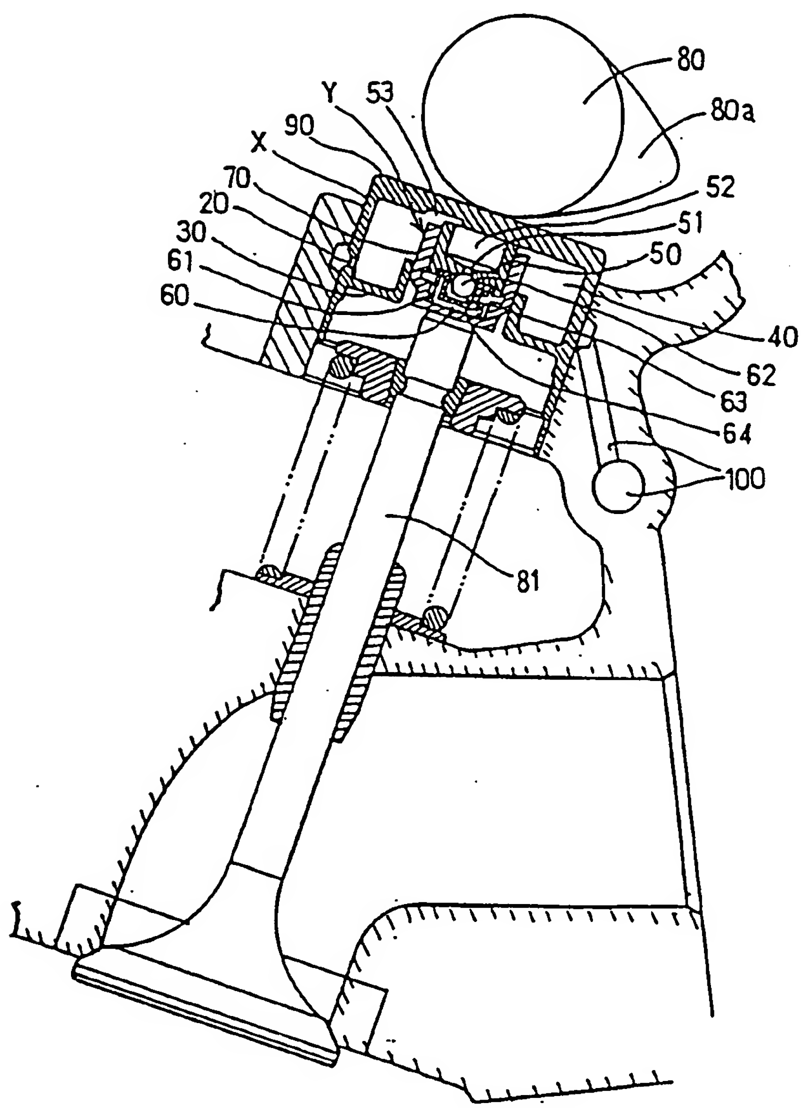
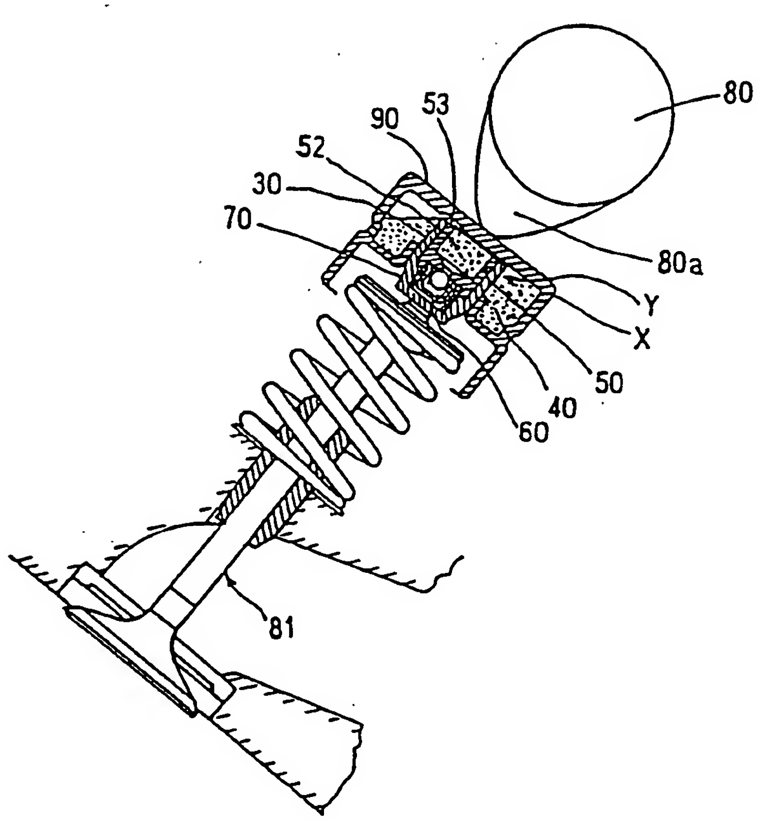


FIG. 34



INTERNATIONAL SEARCH REPORT

International Application No PCT/JP92/00598

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl^5 F01L1/24

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	F01L1/24

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

Jitsuyo Shinan Koho	1920 - 1992
Kokai Jitsuyo Shinan Koho	1971 - 1992

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	JP, A, 63-57803 (INA Walzlager Schaeffler KG.), March 12, 1988 (12. 03. 88), Lines 4 to 18, lower left column, page 5, lines 17 to 18, upper right column, page 6, Figs. 1, 2, 7 & US, A, 4,782,799 & EP, A1, 257,354 & DE, A1, 3,628,619	1, 3, 4, 6
Y	JP, U, 59-194507 (Mitsubishi Metal Corp.), December 24, 1984 (24. 12. 84), Lines 9 to 15, page 9, Fig. 9	2
Y	JP, U, 1-173303 (Nippon Seiko K.K.), December 8, 1989 (08. 12. 89), Line 14, page 15 to line 19, page 16	4
Y	JP, Y2, 3-18648 (Aichi Kikai Kogyo K.K.), April 19, 1991 (19. 04. 91), Line 28, column 4, page 2 to line 9, column 6, page 3	1, 2, 3
A	JP, A, 1-280606 (INA Walzlager Schaeffler KG.),	1, 4

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
July 23, 1992 (23. 07. 92)	August 11, 1992 (11. 08. 92)
International Searching Authority	**Signature of Authorized Officer**
Japanese Patent Office	

International Application No. PCT/JP92/00598

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

November 10, 1989 (10. 11. 89),
Line 5, column 13 to line 8, column 14,
page 4 & DE, A1, 3,810,436 & EP, A1, 335,121
& US, A, 4,876,997

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers , because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers , because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers , because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.